NACIMIENTO WATER PROJECT

Agricultural Noxious Weeds Mitigation Plan

November 2006

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San Luis Obispo County Flood Control & Water Conservation District

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Prepared for:

Environmental Programs Division
Department of Public Works
County of San Luis Obispo

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TABLE OF CONTENTS

Nacimiento Water Project
Agricultural Noxious Weeds Mitigation Plan

Page

Figures

Appendices

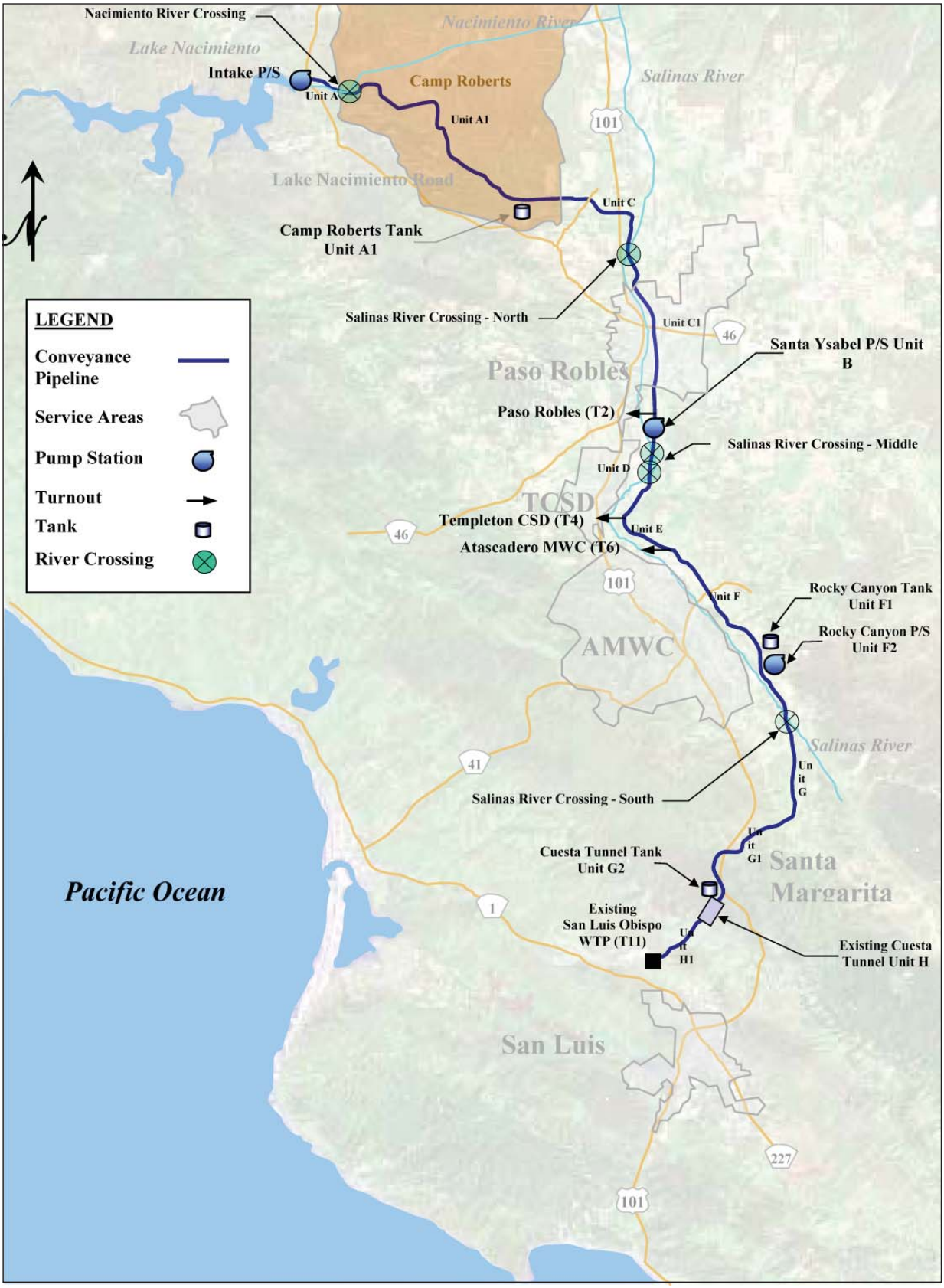
NACIMIENTO WATER PROJECT
Agricultural Noxious Weeds Mitigation Plan

1.0 Introduction

This Agricultural Noxious Weeds Mitigation Plan (ANWMP or Plan) provides guidelines for the implementation of mitigation requirements as set forth in the Project's Environmental Impact Report (EIR) (mitigation measures AG-7, AG-8, and AG-9), for preventing potential long-term impacts of the spread of noxious weeds in agricultural areas resulting from the implementation of the Nacimiento Water Project (NWP or Project). The San Luis Obispo County Flood Control and Water Conservation District (District) is proposing to construct a 45-mile pipeline from Lake Nacimiento to San Luis Obispo (Figure 1), and spread of noxious weeds has the potential to occur as trenching and other equipment is transferred from one area of the Project to another (such as from public road rights-of-way onto or across private land). Any significant effects on agricultural resources must be considered under the Revised Appendix G of the California Environmental Quality Act (CEQA) guidelines. This ANWMP outlines actions that will be taken by the District to avoid, and if necessary mitigate, the spread of these noxious weeds during the NWP.

1.1 Project Summary

The Nacimiento Water Project is designed to provide a reliable supplemental water source for a variety of uses within San Luis Obispo (SLO) County by supplementing the local ground and surface water supplies with a new surface water source. The SLO County Flood Control and Water Conservation District has a 17,500 afy entitlement from Lake Nacimiento per agreement executed in 1959 with Monterey County, and this water will be transported south in a pipeline over 40 miles long with associated turnouts, pumping stations and other associated facilities. The NWP will be constructed within three broad physiographic regions: coastal mountains and valleys, interior mountains and valleys, and a coastal plain. Lake Nacimiento is located in the Santa Lucia coastal mountain range. Major water courses are the Nacimiento and Salinas Rivers and Santa Margarita Creek. Major drainage basins include the Lake Nacimiento Watershed and the Salinas River.



SOURCE: County of San Luis Obispo

Figure 1
Nacimiento Water Project Location

1.2 Responsible Parties

San Luis Obispo County Flood Control and Water Conservation District
Public Works Department
County Government Center, Room 207
San Luis Obispo, CA 93408
Contact: John Hollenbeck, Project Manager
jhollenbeck@co.slo.ca.us (805) 781-1288

2.0 Potential Project Impacts

The proposed NWP pipeline and related facilities are located adjacent to and within various types of agricultural lands and operations. Some areas are used for cattle grazing and other livestock, while other locations are planted with row crops such as wine grapes and vegetables. These agricultural lands could experience long-term detrimental effects from the spread of noxious weeds, when trenching and other equipment is transferred from one area of the project to another during the construction phase of the Project. The SLO County Department of Agriculture identifies several noxious weed species that may exist within the pipeline corridor and could be spread by construction activities, including but not limited to: purple star-thistle (*Centaurea calcitrapa*), yellow star-thistle (*Centaurea solstitialis*), skeleton weed (*Chondrilla juncea*), medusahead (T*aeniatherum caput-medusae*), perennial pepperweed (*Lepidium latifolium*), giant reed (*Arundo donax*), and saltcedar (*Tamarix spp*.), the principle weeds discussed in this Plan (photographs in Appendix B). Mitigation measures to limit the potential impacts, developed for the NWP EIR, are described in Section 6.0. This ANWMP provides additional detail for the implementation of these measures.

2.1 Spread of Purple Star-thistle

Description. This invasive biennial (2-year life cycle) produces sharp, stout spines and purple flowers. Mature plants are up to one and one half meters high, densely and rigidly branched, with numerous flowerheads surrounded by leaves. The leaves are resin-dotted, upper leaves mostly pinnate-divided. The new leaves are densely covered with gray hairs. Purple star-thistle flowers from July to October.

Where it is found in California. This plant most frequently invades recently or repeatedly disturbed areas such as pastures and overgrazed rangelands and along roads, ditches, and fences, usually below 3,000 feet elevation. It is most prolific on fertile soils and seems to prefer heavier bottomland and clay soils. It is found throughout California, except for north and central Cascade Ranges, Modoc Plateau, Great Basin, and desert regions. In SLO County, this plant is a common invader in the areas west of the Santa Lucia Mountains, and just over the Cuesta Grade near Santa Margarita.

Origin. This plant is native to the Mediterranean region of southern Europe and northern Africa. It was first detected in California near Vacaville in 1886, and has recently become established as a rangeland and pasture pest as far north as Washington (Bossard et al., 2000).

Noxious weed status. San Luis Obispo County has multiple programs ongoing to eradicate purple star-thistle, including cattle grazing and the herbicide Clopyralid (Transline) (Ward, 2005).

How it is spread. Purple star-thistle reproduces only by seed. Since the seeds have no pappus (which facilitates dispersal by wind), it is likely that they disperse long distances in hay and straw, on farm and ranch machinery, and through roadside maintenance and construction equipment (Bossard et al., 2000).

Why it is a problem. This pasture pest has sharp spines and bitter taste, so cattle, deer, and rodents avoid eating it. It replaces palatable species in some grazed areas, and dense stands of mature plants can make areas inaccessible to livestock and humans. Its spines are thicker and stronger than those of yellow star-thistle, and do not fall from the plants in autumn like the yellow star-thistle spines do. Because of this, forage that may grow in infested areas after purple star-thistle has senesced in fall and winter may be inaccessible to grazers.

It is unclear whether purple star-thistle can form dense stands in grasslands that do not have heavy grazing, but it is expected that it can, and will replace desirable native species.

2.2 Spread of Yellow Star-thistle

Description. This annual plant grows up to one meter tall, and produces one to many solitary, spiny, yellow flower-heads. Flowerheads are generally produced from June through September. The main flowerhead bracts (phyllaries) are palmately spined with a single, stout, apical spine and a few smaller spines. Leaves are basal. Yellow star-thistle can be distinguished from other yellow thistles by its long central spines (10-25 mm).

Where it is found in California. Yellow star-thistle is widely distributed in the Sacramento and northern San Joaquin Valleys, inner North Coast Ranges, northern Sierra Nevada Foothills, Cascade and Klamath Ranges, and the central-western regions of the state. It is currently spreading in mountain regions of the state below 2,286 meters and in the central-western region. Yellow star-thistle is common in many portions of SLO County, although there are also large regions of the County that are not currently infested.

Origin. This plant is native to southern Europe and western Eurasia, and was first collected in Oakland, California in 1869. It was probably introduced after 1848 as a contaminant of alfalfa seed (Bossard et al., 2000).

Noxious weed status. Yellow star-thistle is one of the most prominent noxious weeds in California, infesting more than 12 million acres throughout the State. It is extremely competitive, invading cropland, pastures, and rangeland, increasing farming costs and reducing productivity. San Luis Obispo County has multiple eradication programs targeted at yellow star-thistle, using timed cattle grazing, herbicides (glyphosate [Roundup®, Rodeo®], Clopyralid [transline®]), hand removal, mulching, and cover crops. All control measures must be conducted prior to seed production and dispersal, which occurs from late May through July (Ward, 2005).

How it is spread. Human activities are the primary mechanism for long distance movement of yellow star-thistle seed, for example, by road maintenance equipment and on the undercarriage of vehicles. Once at a new location, seed is transported in lesser amounts and over short to medium distances by animals and humans. The short, stiff, pappus bristles are covered with microscopic, stiff, hair-like barbs that can adhere to clothing, hair, and fur.

Why it is a problem. Because yellow star-thistle is highly competitive and often forms dense stands, it displaces native plants and animals, threatening ecosystems and nature reserves. It also significantly depletes soil moisture reserves in annual grasslands in California. Long-term ingestion by horses causes a neurological disorder known as chewing disease, a lethal lesion of the nigropallidal region of the brain. This disease is expressed as a twitching of the lips, tongue flicking, and involuntary chewing. Permanent brain damage is possible, and affected horses may starve to death. Yellow star-thistle interferes with grazing and lowers yield and forage quality of rangelands, thus increasing livestock management costs. It also reduces the land value, and limits access for recreational use.

2.3 Spread of Skeleton Weed

Description. This herbaceous perennial grows up to one and one half meters tall, with small leaves that give it a "skeleton-like" appearance, wiry flowering stems, and small yellow flowers. It has a deep taproot of two meters or more. Skeleton weed flowers from July until the flowering stems are killed by frost (fall or winter). It overwinters as a rosette of hairless, basal leaves that are five to thirteen centimeters long, up to five centimeters wide, and broader at the tip (similar to dandelion leaves). A distinguishing characteristic of this plant is the downward pointing stiff hairs at the stem's base. This plant exists in scattered locations along the proposed pipeline.

Origin. This plant was introduced from Eurasia, and first discovered in California in 1965.

Where it is found in California. Skeleton weed is found in disturbed soils of roadsides, croplands, especially irrigated grain fields, semi-arid pastures, rangelands, and residential properties. It is very invasive in other western states, but currently limited in distribution in California. Its range includes the Cascade Ranges, the South Coast Ranges, Central Valley, Northwest, and the northern Sierra Nevadas. Previous infestations now eradicated occurred in Tehama, Butte, Solano, San Mateo, Madera, Santa Barbara, and San Diego counties.

Noxious weed status. Skeleton weed is a weed pest of quarantine significance to SLO County and California, and its potential spread is controlled by a set of quarantine regulations. SLO County Department of Agriculture is currently working to eradicate skeleton weed on right of ways and roadsides, using mechanical methods (hand pulling) and herbicides (Glyphosate [Roundup®, Rodeo®] and Clopyralid [Transline®]) (Ward, 2005).

How it is spread. Skeleton weed has parachute-like seeds that are dispersed primarily by wind, but also by animals, water, and human activity.

Why it is a problem. Persistent flower stems can hinder harvest machinery. Plants are highly competitive for water and nutrients, and can outcompete native and beneficial species.

2.4 Spread of Perennial Pepperweed

Description. This multi-stemmed herb grows one to two and one half meters tall with a heavy, sometimes woody, crown and a spreading underground root system. Tiny white flowers are borne in dense clusters at the tops of the stems. Leaves are lanceolate, and gray to bright green. Larger leaves occur at the plant base. Flowering from May to July, plants produce many small, roundish, light brown fruits.

Origin. Native to Eurasia, with its first California published recording in 1936 (Bossard et al., 2000).

Where it is found in California. Brackish to saline or alkaline wetlands throughout California. It has been found in all counties in California except Del Norte, Humboldt, and Imperial.

In SLO County perennial pepperweed has a limited distribution. However, one of the areas where it is known to occur is in the Salinas River from San Miguel south to the Wellsona crossing, where Project maps indicate the pipeline will be installed. SLO County is extremely concerned that perennial pepperweed could be inadvertently spread upstream from the Wellsona crossing into the upper portions of the Salinas River watershed that are currently uninfested (Marc Lea, SLO County Dept. of Agriculture, pers. comm., September 27, 2006).

How it is spread. Distributed by seeds or by pieces of underground stems. The seeds are capable of being transported by wind, water, and possibly waterfowl. Root fragments and seeds float and disperse with flooding, soil movement, and agricultural and other human activities. Seeds can also cling to tires, shoes, and the feet, fur, and feathers of animals and contaminate hay or crop and pasture seed. Root fragments as small as 1-2 cm long and 2-8 mm in diameter can develop into new plants. Cleaning agricultural or earth-moving machinery after use in infested areas and curtailing movement or use of soil, hay, and crop or pasture seed contaminated with perennial pepperweed root fragments and/or seed can help prevent new infestations (CDFA, 2006).

Why it is a problem. Perennial pepperweed is an aggressive invader of coastal and interior wetlands throughout California. It forms dense monocultures that exclude other plants, including natives. In most areas it prefers habitat slightly higher than that dominated by pickleweed (*Salicornia spp.),* but it has invaded *Salicornia*-dominated marshes in the Alviso Slough area, and thus poses a threat to the habitat of the endangered salt marsh harvest mouse, California black rail, and California clapper rail. In waterfowl nesting areas it outcompetes grasses that provide food for waterfowl. It is also an aggressive invader of some agricultural lands in the Central Valley and east of the Sierra Nevada (Bossard et al., 2000). It is very hard to control due to its profuse seed production and extensive creeping root system.

2.5 Spread of Medusahead

Description. Slender annual grass. Three to eight cm awns are straight and compressed when green, but upon drying, the awns twist and spread erratically. It matures from two to four weeks later than most other annual grasses, displaying distinctive patches of green in an otherwise brown grassland (Bossard et al., 2000).

Origin. Native to Spain, Portugal, southern France, Morocco, and Algeria. It was introduced into the United States in the late 1800s (Bossard et al., 2000).

Where it is found in California. Invades grasslands, oak savannah, oak woodland, and chaparral communities. Grows best on clay soils or where deep soil moisture is available late in the growing season. It is currently known to occur in over twenty counties in California. In SLO County, it is known to have small infestations on Camp Roberts and a few locations in the Paso Robles area within fairly close proximity to the Project pipeline; however, it is likely that its actual range is much larger than is currently known, especially in the northern portion of the County (Marc Lea, pers. comm., September 27, 2006).

How it is spread. This grass reproduces by seed, which is dispersed locally by wind and water. The long-awned seeds cling to the coats of grazing animals, such as sheep or cattle, and in this way are transported to more distant sites. Seeds can also disperse by attaching to machinery, vehicles, and clothing.

Why it is a problem. Medusahead outcompetes native grasses and forbs, and, once established, can reach densities of 1,000 to 2,000 plants per square meter. After seeds set, the silica-rich plants persist as a dense litter layer that prevents germination and survival of native species, ties up nutrients, and contributes to fire danger in summer. Because of its high silica content, medusahead is unpalatable to livestock and native wildlife except early in the growing season. The sharp awns can injure the eyes and mouths of livestock (Bossard et al., 2000).

2.6 Spread of Giant reed

Description. Robust perennial grass three to ten meters tall, growing in many-stemmed, cane-like clumps, spreading from horizontal rootstocks below the soil, and often forming large colonies many meters across. Individual stems are tough and hollow, divided by partitions at nodes like bamboo. The pale green to blue-green leaves, which broadly clasp the stem with a heart-shaped base and taper to the tip, are up to two feet or more in length. Leaves are arranged alternately throughout the culm, and lie in a single plane. Giant reed produces a tall, plume-like flowerhead at the upper tips of stems, the flowers closely packed in a cream to brown cluster borne from early summer to early fall. Giant reed can be confused with cultivated bamboos and corn, and in earlier stages with some large-stature grasses such as *Leymus* (ryegrass), and especially with *Phragmites* (common reed), which is less than ten feet tall and has panicles less than one foot long with long hairs between the florets (Bossard et al., 2000).

Origin. Giant reed is often considered indigenous to the Mediterranean Basin or to warmer regions of the Old World, but apparently it is an ancient introduction into Europe from the Indian sub-continent. It was abundant by 1820 in Los Angeles River, where it was harvested for roofing material and fodder (Bossard et al., 2000).

Where it is found in California. Giant reed is found in central and southern California, usually below 300 meters elevation. It is most problematic in coastal river drainages of southern California, where it sometimes occupies entire river channels from bank to bank. The largest colonies occur in riparian areas and floodplains of medium-sized to large streams, from wet sites to dry river banks far from permanent water (Bossard et al., 2000).

Historically, giant reed has occurred within the Nacimiento and Salinas River channels, which the Project pipeline route travels alongside for many miles. Fortunately, the distribution of giant reed in SLO County is currently low, but regardless it has been found within close proximity to the Project area. This plant may have already been eradicated from the Nacimiento River and plans are in process for eradicating it from the entire portion of the Salinas watershed that lies within SLO County, as well as future efforts being considered further downstream (in Monterey County) (Marc Lea, SLO County Dept. of Agriculture, pers. comm., September 27, 2006).

How it is spread. Giant reed spreads vegetatively either by rhizomes or fragments.

Why it is a problem. Giant reed displaces native plants and associated wildlife species because of the massive stands it forms. Competition with native species has been shown to result from monopolization of soil moisture and by shading. As giant reed replaces riparian vegetation in semi-arid zones, it reduces habitat and food supply, particularly insect populations, for several special status species such as least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), and yellow-billed cuckoo (*Coccyzus americanus*). Unlike native riparian plants, giant reed provides little shading to the in-stream habitat, leading to increased water temperatures and reduced habitat quality for aquatic wildlife. At risk are protected species such as arroyo toad (*Bufo californicus*), red-legged frog (*Rana aurora*), western pond turtle (*Emys marmorata*), Santa Ana sucker (*Catostomus santaanae*), arroyo chub (*Gila orcutti*), unarmored threespine stickleback (*Gasterosteus aculeatus*), tidewater goby (*Eucyclogobius newberryi*), and southern steelhead trout (*Oncorhyncus mykiss iridius*), among others (Bossard et al., 2000).

Giant reed is also suspected of altering hydrological regimes and reducing groundwater availability by transpiring large amounts of water from semi-arid aquifers. It alters channel morphology by retaining sediments and constricting flows, and in some cases may reduce stream navigability.

Dense growth presents fire hazards, often near urbanized areas, more than doubling the available fuel for wildfires and promoting post-fire regeneration of even greater quantities of giant reed. Uprooted plants also pose clean-up problems when deposited on banks or in downstream estuaries and during floods create hazards when trapped behind bridges and other structures.

Although often planted for erosion control, giant reed can promote bank erosion because its shallow root system is easily undercut and bank collapse may follow (Bossard et al., 2000).

2.7 Spread of Saltcedar

Description. The *tamarix* species are many-branched shrubs or trees less than twenty-six feet tall with small scale-like leaves, from which comes the name saltcedar. Leaves have salt glands, and salt crystals an often be seen on the leaves. Small white to deep pink flowers are densely arranged on racemes. The bark is reddish brown with smooth stems less than two cm in diameter.

Origin. Saltcedar is from central Asia. Although saltcedar may have been introduced into North America by the Spaniards, it did not gain recognition in the western United States until the 1800s. It was planted widely for erosion control, as a windbreak for shade, and as an ornamental (Bossard et al., 2000).

Where it is found in California. Saltcedar is widely distributed throughout the Mojave and Colorado deserts, Owen's valley, the Central and South coasts, and the San Joaquin Valley. It is abundant where surface or subsurface water is available for most of the year, including stream banks, lake and pond margins, springs, canals, ditches, and some washes. Disturbed sites, including burned areas, are particularly favorable for saltcedar establishment. It survives, and even thrives, on saline soils where most native, woody, riparian plants cannot (Bossard et al., 2000).

Historically, saltcedar has occurred within the Nacimiento and Salinas River channels, which the Project pipeline route travels alongside for many miles. Fortunately, the distribution of saltcedar in SLO County is currently low, but regardless it has been found within close proximity to the Project area. This plant may have already been eradicated from the Nacimiento River and plans are in process for eradicating it from the entire portion of the Salinas watershed that lies within SLO County, as well as future efforts being considered further downstream (in Monterey County) (Marc Lea, SLO County Dept. of Agriculture, pers. comm., September 27, 2006).

How it is spread. Saltcedar spreads by seed and vegetative growth. Individual plants can produce 500,000 tiny seeds per year, which are easily dispersed long distances by wind and water. The roots also sprout adventitiously.

Why it is a problem. Geomorphological impacts include trapping and stabilizing alluvial sediments, which results in narrowing of stream channels and more frequent flooding. Saltcedar has been blamed for lowering water tables because of its high evapotranspiration rate, and on a regional scale, dense saltcedar groves use far more water than native riparian plant associations.

Soil salinities increase as a result of inputs of salt from glands on saltcedar leaves. The dome-shaped glands consist of at least two cells embedded in the epidermal pits. Increased salinity inhibits growth and germination of native riparian species. Leaf litter from drought-deciduous saltcedar increases the frequency of fire. Saltcedar is capable of resprouting vigorously following

fire and, coupled with changes in soil salinity, ultimately dominates riparian plant communities (Bossard et al., 2000).

3.0 Monitoring Plan

The NWP Agricultural Noxious Weeds Mitigation program described in this and the following section is designed to document the current locations of noxious weeds, minimize the spread of these weeds, and identify strategies for eradicating any weeds that have spread to other areas as a result of NWP-related construction activities.

3.1 Preconstruction Identification and Flagging

The District will consult with the Agricultural Commissioner's Office in order to assure that pre-construction surveys for purple star-thistle, yellow star-thistle, and skeleton weed (or additional species as directed by the Commissioner) are performed adequately. These surveys shall be conducted by a qualified botanist familiar with the species. Surveys should occur prior to construction and during a time of year when the plants are easily detected (flowering of all three species occurs from June to September). Surveys shall concentrate both within and adjacent to the NWP corridor, corridor access routes, and staging areas. The location of all noxious weed infestations shall be documented using GPS coordinates, and flagged for construction workers to avoid. Results from the pre-construction surveys for noxious weeds shall be documented using pre-construction survey forms (Appendix A). In addition, all communication with the Agricultural Commissioner's Office, as well as survey results, shall be reported by the Biological Monitor[1] to the District. Before the start of NWP construction, all survey forms will be combined in a single Pre-construction Weed Distribution Report, prepared by the Biological Monitor and submitted to the District.

3.2 Post-construction Identification

A qualified botanist shall conduct agricultural noxious weed monitoring during the spring, immediately following each year of project construction. If monitoring reveals the spread of noxious weeds from pre-project conditions, the additional areas should be mapped using a GPS-based system equivalent to the preconstruction methodology, and the District should coordinate with the affected landowner and the County Department of Agriculture to implement an appropriate eradication method (Section 4.0). Post-construction survey results and suggested eradication plans shall be documented using post-construction survey forms. The form shown in Appendix A is essentially the same as the preconstruction form, with a field added for the suggested treatment. All survey forms will be combined into a single Post-construction Weed Distribution Report, prepared by the Biological Monitor and submitted to the District.

The District will be responsible for new infestations deemed to occur as a result of the Project.

[1] The Biological Monitors are the individuals designated by the County as the responsible parties for ensuring implementation of the EIR Mitigation Measures and regulatory permit conditions (see ESA, 2006).

4.0 Control and Eradication Methods

To avoid or mitigate the spread of noxious weeds, it is important to prevent large-scale infestations by controlling new invasions. Prevention is the optimal approach; if this is unsuccessful, spot eradication is the least expensive and most effective method of preventing establishment of many of these weeds. In established stands, any successful control strategy will require dramatic reduction or, preferably, elimination of new seed production, multiple years of management, and follow-up treatment or restoration to prevent rapid reestablishment.

Effective control using any of the available techniques (i.e., mechanical methods, prescribed burning, biological control, mowing, grazing, plant competition, or chemical control) depends on proper timing. Combinations of techniques may prove more effective than any single technique. For example, combining mowing and grazing, revegetation and mowing, or herbicides and biological control may provide better control than any of these strategies used alone. Effective combinations may depend on location, or on the objectives and restrictions imposed on landowners and managers.

4.1 Preventing Weeds from Spreading During Construction

Cleaning. The District shall require the contractor to implement equipment wash stations and other pertinent noxious weed control measures based on the preconstruction mapping of noxious weed infestation locations.

Avoidance. Areas containing noxious weeds shall be avoided as much as possible during NWP implementation.

During construction, topsoil shall be segregated and replaced in its original distribution. To the maximum extent feasible, excavated materials should not be transported offsite.

4.2 Purple Star-thistle Eradication

Manual. Grubbing or digging can control small infestations. Plants should be cut at least 5 cm below the soil surface early in the growing season. They are easiest to see after bolting, but should be cut before flowering in order to prevent the release of viable seed. If plants are cut after flowering, they should be removed from the site and destroyed. Follow-up treatments are necessary, as field tests have shown that 10-15% of plants cut below the root crown may resprout.

Mechanical and prescribed burning. Mowing is not an effective method of control, because the rosettes are too low to be cut and plants that have already bolted often respond to mowing by producing multiple rosettes. Mowing plants that have begun to flower will spread the cut flowerheads, which may still be capable of dropping mature seed. Burning is also ineffective, as it removes current growth but may enhance seed germination.

Insects and fungi. There is no biological control program for purple star-thistle. Two species of *Bangasternus* seed head weevils that control yellow star-thistle in Europe are reported to have "biotypes" that feed on purple star-thistle, but there are no plans to introduce these weevils to North America.

Chemical. Clopyralid, 2,4-D and dicamba provide effective control of purple star-thistle. Late winter or spring application is recommended because the seedlings and rosettes are most sensitive at this time (Bossard et al., 2000).

4.3 Yellow Star-thistle Eradication

Mechanical. Tillage can control this thistle; however, this will expose the soil for rapid reinfestation if subsequent rainfall occurs. During dry summer months, tillage practices designed to detach roots from shoots prior to seed production are effective. For this reason, the weed is rarely a problem in agricultural crops. Weedeaters or mowing can also be used effectively. However, mowing too early, during the bolting or spiny stage, will allow increased light penetration and more vigorous plant growth and high seed production. Mowing is best when conducted at a stage where 2-5% of the seed heads are flowering, and when the lowest branches of plants are above the height of the mower blades. Results should be repeatedly monitored, as two or three attempts may be necessary to ensure reduced recovery and seed production (Bossard et al., 2000).

Prescribed burning. Burning can provide effective control and enhance the survival of native forbs and perennial grasses. It is most effective after native species disperse their seeds but before yellow star-thistles produce theirs (June-July).

Insects and fungi. Six USDA approved insect species that feed on yellow star-thistle have become established in California. These include three weevils and three flies (Table 1). All of these insects attack yellow star-thistle flowerheads, and the larvae utilize the developing seeds as a food source. Of the four insects that are well established in California (Villegas et al.., 2000) only two, the false peacock fly and the hairy weevil, have any significant impact on seed production. The combination of these two insects has been reported to reduce seed production 43-76% (Pitcairn and DiTomaso, 2000). Although this level of suppression is not sufficient to provide long-term star-thistle management, the use of biological control agents can be an important component of an integrated management approach.

Grazing. Intensive grazing by sheep, goats, or cattle before the spiny stage but after bolting can reduce biomass and seed production in yellow star-thistle. To be effective, large numbers of animals must be used for short durations. Grazing is best between May and June, but depends on location. This can be a good forage species.

Plant competition. Revegetation with annual legumes capable of producing viable seed provides some level of control in pastures. Subterranean clover (*Trifolium subterraneum)* and rose clover

(*T. hirtum)* can both effectively compete with yellow star-thistle. Plant competition is more successful when combined with repeated mowing.

TABLE 1

YELLOW STAR-THISTLE BIOLOGICAL CONTROL INSECTS

Species	Common name	Current establishment in California	Impact
Bangasternus orientalis	Seed-head weevil	Wide	Low
Urophora sirunaseva	Seed-head fly	Wide	Low
Urophora sirunaseva	Seed-head fly	Wide	Low
Eustenopus villosus (= E. hirtus)	Hairy weevil	Wide	Moderate
Chaetorellia australis (= C. hexachaeta)	Peacock fly	Limited	Low
Chaetorellia succinea	False peacock fly	Wide	Moderate
Larinus curtus	Flower weevil	Limited	Low

SOURCE: (DiTomaso, 2006)

Chemical. Although several non-selective pre-emergence herbicides will control yellow star-thistle, few of these can be used in rangeland or natural ecosystems. The exception is chlorsulfuron, which provides good control in winter when combined with a broadleaf selective post-emergence compound. However, chlorsulfuron is not registered for use in rangelands or pastures.

The primary options for control in non-crop areas are post-emergence herbicides; 2,4-D, triclopyr, dicamba, and glyphosate. All but glyphosate are selective and preferably applied in late winter or early spring to control seedlings. Once plants have reached the bolting stage, the most effective control can be achieved with glyphosate (1% solution). The best time to treat with glyphosate is after annual grasses or forbs have senesced, but prior to yellow star-thistle seed production (May-June). The most effective compound for yellow star-thistle control is clopyralid, which provides excellent pre-emergence and post-emergence control (Bossard et al., 2000).

4.4 Skeleton Weed Eradication

Mechanical. Tillage will effectively eliminate skeleton weed seedlings and older plants. However, new plants will rapidly reestablish from severed rootstocks as small as 2 cm and from a depth of 120 cm. Mowing will reduce the number of viable seeds produced. However, the plants will persist due to vegetative reproduction. Mowing after initial seed set is not recommended and will likely increase seed dispersal.

Insects and fungi. Three organisms have been released for control of skeleton weed in California: skeleton weed gall midge (*Cystiphora schmidti*), skeleton weed gall mite (*Eriophyes chondrillae*), and skeleton weed rust (*Puccinia chondrillina*) (a fungus). The gall midge attacks all known biotypes of skeleton weed. The larvae feed on the leaves and stems at the site of egg deposition, which results in the formation of galls. Infested plants show reduced vigor and early senescence, with decreases in viable seed production and stem size and length. One of the best strategies for use is collecting stems with galls from an infested patch, removing any seed heads or flowers, tying the stems into teepee bundles, and placing them in the center of uninfested patches.

The gall mite has several generations per year and has been the most effective agent released for skeleton weed control. The mites attack shoot buds when plants bolt in the spring, and continue to form galls until the fall. Infested plants exhibit deformed shoot buds, and produce few to no viable seed. The mite also reduces vegetative reproduction by reducing carbohydrate reserves and preventing new rosettes from establishing from the original plant. After seed head and flower removal, gall-infected stems may be placed against new uninfested plants, and colonization should occur.

The rust has multiple generations per year and has demonstrated considerable success in California. Large pustules form on leaves and stems of rosettes and mature plants alike, resulting in stunted, deformed plants, with reduced branching and floral bud production. Infected plants produce less viable seeds. This rust can be spread by placing infected stems in patches of healthy plants. It should be noted that different biotypes of skeleton weed have shown resistance to this rust in Australia. The narrowleaf biotype is susceptible, while the intermediate and broadleaf types appear to be resistant to the fungus. Though successful, it may take up to four years before results are highly visible.

Grazing. In rangeland areas, proper grazing management and fertilization will help prevent its establishment. Where infestations are present, cattle and sheep will readily graze the rosettes and shoots until the stems become lignified (woody). Grazing will reduce seed production, and few viable seed will pass through a ruminant digestive system.

Chemical. There are few herbicides registered for control of skeleton weed. Picloram (Tordon) and metsulfuron methyl (Escort) have been effective in controlling skeleton weed, but are not currently labeled for use in California. Tank mixes of clopyralid (Transline) and MCPA or 2,4-D have been shown to be more effective than MCPA or 2,4-D alone. Glyphosate will control rosettes, but is nonselective and will kill any desirable vegetation. New rosettes will emerge, and flourish without competition. Each of the available herbicides in California has different timings and effects on vegetation (Table 2). Unfortunately, all the currently labeled herbicides may kill or injure important legumes, and reestablishment strategies for legumes following herbicides have not been well documented.

TABLE 2

HERBICIDE RECOMMENDATIONS FOR SKELETON WEED CONTROL

Herbicide	Timing	Remarks
Clopyralid	Spring, rosette to early bolting	Will kill annual and perennial legumes
MCPA	Spring, early bolting	May injure legumes and any other broadleaves
2,4-D	Spring, early bolting	May injure or kill legumes and any other broadleaves

SOURCE: California Dept of Food and Agriculture, 2006

4.5 Perennial Pepperweed Eradication

Mechanical. Mechanical methods are unlikely to control perennial pepperweed because new plants quickly regenerate from pieces of rootstock left in the soil. Segments shorter than two cm are capable of resprouting. Disking of perennial pepperweed has shown to actually increase their distribution.

Prescribed burning. Fire alone is unlikely to be effective in controlling perennial pepperweed, in part because typical fuel loads in infestations of this plant are inadequate to sustain burns.

Inundation. Perennial pepperweed may be intolerant of prolonged inundation. It does not appear to survive lengthy periods of flooding during the growing season.

Insects and fungi. Development of a biological control program seems unlikely because of risks to many important crop plants that are members of the mustard family (Brassicaceae). Additionally, several native *Lepidium* species from the western United States are either listed as endangered or are being considered for listing. Fifteen species of *Lepidium* are native to California, including four that are considered rare and endangered by the California Native Plant Society .

Chemical. Attempts have been made to control perennial pepperweed with chemical herbicides in California, Oregon, Wyoming, Idaho, and Utah. The only effective herbicide that is registered for use in California is chlorsulfuron (as Telar®) (Bossard et al., 2000).

4.6 Medusahead Eradication

Mechanical. Tilling for seedbed preparation will control existing medusahead plants. Tillage may also bury seed and break up deep thatch layers. However, the increased potential for soil erosion, loss of soil moisture, loss of organic matter, and loss of microbiotic crusts may outweigh the immediate benefits of tillage. Careful consideration of these factors should be made before utilizing tillage in rangeland or wildland areas.

Mowing is generally nonselective and fails to remove the meristems where new growth originates. Along roadsides, mowing is not recommended after seed set due to the increased potential for seed dispersal (CDFA, 2006).

Prescribed burns. Several studies have shown that burning stands of medusahead prior to seed dispersal is an effective control measure. Burns should be scheduled for late spring, after seed set but before seed heads have shattered. Seeds still on the plants are destroyed by the burn, while dispersed seeds lying on or buried below the soil surface are protected from the intense heat of the burn. With few seed reserves in the soil, medusahead abundance can be dramatically reduced if the seed input for even one year is eliminated.

This method takes advantage of the fact that medusahead matures later than most of the surrounding vegetation, so most other species have already dispersed their seeds and are dry enough to carry a burn. At the Jepson Prairie Preserve in Solano County effective control burns were conducted in late May and early June. Proper timing may vary depending on local conditions and weather. Some studies have found medusahead to increase after burning, but most of these studies conducted burns in August, presumably after seed dispersal.

Insects and fungi. No insect or fungal control agents are known. However, some preliminary research has been done on the effect of dry soil conditions on infestations of crown rot (*Fusarium culmoron*), a soil-borne pathogen, on medusahead.

Grazing. Heavy grazing by sheep in early spring (when medusahead is still palatable) can assist in controlling medusahead, but animals should be removed before seed heads form to limit seed dispersal. Early spring grazing is especially effective in areas where dried medusahead litter has been previously burned or grazed. Fertilizing with nitrogen improves the palatability of medusahead. Properly timed grazing may reduce, but not eliminate, medusahead infestations (Bossard et al., 2000).

Chemical. Small-scale infestations can be controlled by chemical herbicides. Atrazine can be effective, however it may injure perennial grass seedlings and a fallow period prior to grass seedling is necessary. This period may be up to twelve months. Atrazine is currently labeled on a very limited basis for use in rangelands in some states but is not labeled in California (CDFA, 2006).

4.7 Giant Reed Eradication

Manual. Minor infestations can be eradicated by manual methods, especially where sensitive native plants and wildlife may be damaged by other methods. Hand pulling is effective with new plants less than two meters in height, but care must be taken that all rhizome material is removed. This may be most effective in loose soils and after rains have made the substrate workable. Plants can be dug up using hand tools (pick-ax, mattock, and shovel), especially in combination with cutting of stems near the base with pruning shears, machete, or chainsaw. Stems and roots should be removed or burned on site to avoid re-rooting, or a chipper can be used to reduce material,

although clogging by the fibrous material makes chipping difficult. For larger infestations on accessible terrain, heavier tools may facilitate biomass reduction, followed by rhizome removal or chemical treatment. Such methods may be of limited use on complex or sensitive terrain or on slopes over 30 percent, any may interfere with reestablishment of native plants and animals.

Mechanical. Mechanical eradication is extremely difficult, even with a backhoe, as rhizomes buried under one to three meters of alluvium readily resprout. Removal of all such material is infeasible, especially where extensive soil disturbance would be disruptive (Bossard et al., 2000).

Prescribed burning. In most circumstances burning of live or chemically treated material should not be attempted, as it cannot kill the underground rhizomes and probably favors giant reed regeneration over native riparian species. Burning in place is problematic because of the risks of uncontained fire, the possibility of damage to beneficial species, and the difficulties of promoting fire through patchily distributed stands. There may be some cases where burning of attached material can be done, but only if other means of reducing biomass cannot be carried out. Cut material is often burned on site, subject to local fire regulations, because of the difficulty and expense involved in collecting and removing or chipping all material.

Insects and fungi. No biological control agents against giant reed have been approved by the USDA, although some invertebrates are known to feed on the grass in Eurasia/Africa.

Grazing. Vertebrate grazers such as cattle and sheep may be useful in controlling giant reed, and Angora goats have been partially successful in reducing this plant and other brush in southern California. Grazers are unlikely to reduce population size sufficiently to eliminate the risks posed. Likewise, management of native plants to increase competition with giant reed probably provides insufficient control, and in fact seems to offer little resistance against the invading reeds.

Chemical. In many, if not all, situations it may be necessary to use chemical methods to achieve eradication, especially in combination with mechanical removal. The most common herbicidal treatment against giant reed is glyphosate, primarily in the form of Rodeo®, which is approved for used in wetlands. Because glyphosate is a broad-spectrum herbicide, care should be taken to avoid application or drift onto desirable vegetation. Most effective application is post-flowering and pre-dormancy, usually late August to early November when plants are translocating nutrients into root and rhizomes. Foliar uptake and kill may be achieved by spray application during active growth periods, primarily late spring through early fall. Small patches can be treated from the ground using backpack or towed sprayers, and major infestations have been aerially sprayed using helicopters.

Direct treatment to cut culms can reduce herbicide costs and avoid drift onto desirable plants, with fair results year-round and best kill in fall, although it appears to be more successful in shaded sites. Concentrated glyphosate solution is applied to stems, cut within four to ten cm of the substrate, by painting with a cloth-covered wand or a sponge or spraying with a hand mister. Solution must be applied immediately following cutting because translocation ceases within minutes of cutting; a five-minute maximum interval is suggested.

New growth is sensitive to herbicides, so a common alternative is to cut or mow a patch and allow regeneration, returning three weeks to three months later when plants are one to two meters tall to treat new growth by foliar spraying of glyphosate. Promoting regrowth causes nutrients to be drawn from the roots, potentially reducing the movement of glyphosate to the roots. With all methods, follow-up assessment and treatment should be conducted, and some professional applicators suggest six return spot treatments over six months. Other chemical control methods have been tested, including paraquat and triclopyr compounds, but are not recommended near water (Bossard et al., 2000).

4.8 Saltcedar Eradication

Mechanical. Saltcedar is difficult to kill with mechanical methods, as it is able to resprout vigorously following cutting or burning. Root plowing and cutting are effective ways of clearing heavy infestations initially, but these methods are successful only when combined with follow-up treatment with herbicides. Seedlings and small plants can be uprooted by hand.

Prescribed burning. Fire does not kill saltcedar roots, and plants return quickly after fire if untreated by other methods. Fire is valuable primarily for thinning heavy infestations prior to follow-up application of herbicide. The consequences of fire for native plants and soil chemistry must be recognized.

Flooding. Flooding thickets for one to two years can kill most saltcedar plants in a thicket.

Insects and fungi. The USDA is currently using an international team of researchers to test thirteen species of natural enemies to control saltcedar. Ot these, two have been recommended for field release in the United states, including a mealybug (*Trabutina mannipara*) from Israel and a leaf beetle (*Diorhabda elongata*) from China. Two other species are being tested in quarantine, including a psyllid (*Colposcenia aliena*) and a gelechiid leaf tier (*Ornativalva grisea*) from China. A gall midge (*Psectorsema*) from France has been approved for quarantine testing.

Grazing. Cattle have been shown to graze significant amounts of sprout growth.

Chemical. Heavy infestations may require stand thinning through controlled burns or mechanical removal with heavy equipment prior to treatment with herbicides. Six herbicides are commonly used to combat saltcedar, including imazapyr, triclopyr, and glyphosate. Perhaps the best method is to apply an imazapyr marketed as Arsenal to the foliage. This technique is especially effective when a tank mix is used with a glyphosate herbicide such as Rodeo® or RoundupPro®. The most frequently used method in California is to cut the shrub off near the ground and apply triclopyr. This technique usually results in better than a 90 percent kill rate. Triclopyr can even be applied directly to the basal bark of stems less than about ten cm in diameter without cutting the stem (Bossard et al., 2000).

5.0 Authors and References

5.1 Report Authors

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5.2 References

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6.0 Mitigation Measures

6.3 Mitigation Measure AG-7 of the Nacimiento Water Project EIR (MRS, 2003)

Prior to construction, the District shall coordinate with the Agricultural Commissioner's Office to assure that pre-construction evaluations for purple star-thistle, yellow star-thistle, and skeleton weed are performed adequately.

-Based on the pre-construction survey, the District shall prepare a map showing areas of noxious weed infestation on lands both within and adjacent to the proposed project corridor, corridor access routes, and staging areas.

-The District shall implement equipment wash stations and other pertinent noxious weed control recommendations based on the above required map.

-The District shall perform post-construction surveys during the spring growing season immediately following each phase of project construction to verify whether the spread of noxious weeds has occurred.

-If the post-construction survey identifies spread of noxious weeds, the District shall coordinate with the affected landowner and the County Department of Agriculture to implement an appropriate eradication program.

6.4 Mitigation Measure AG-8 of the Nacimiento Water Project EIR (MRS, 2003)

During construction, topsoil shall be segregated and replaced relative to its original distribution. To the maximum extent feasible, excavated materials shall be replaced in the same location they were removed from, and shall not be transported offsite.

6.5 Mitigation Measure AG-9 of the Nacimiento Water Project EIR (MRS, 2003)

Prior to construction, the District will enter into a Quarantine Compliance Agreement with the San Luis Obispo County Agricultural Commissioner's Office for the prevention of movement of skeleton weed.

APPENDIX A

Weed Observation and Monitoring Forms and Data Standards

Pre-Construction Weed Monitoring Form

(California Department of Food and Agriculture [CDFA], 2002)

(Fields marked with a * are required)

METADATA	
Collection date (mm/dd/yyyy)*	
Observer name*	
Observer contact information*	Address:
	City: State: Zip:
	Phone:
	Email:
Source of the data*	Organization name or WMA Code:
Hand-annotated map ID	
SITE DESCRIPTION	
Site name or ID*	
Site address or description	
State*	
County*	
National ownership*	
Local ownership	Landowner name:
Quad name	
HUC number	
Land use type	□ Ag □Rangeland □ Rural Res. □ Urban □ Indust/Comm. □Other
Invaded vegetation type	□ Forest □ Woodland □ Chap/Scrub □ Grassland □ Herb □ Aquatic-Fr □ Aquatic-Sa □ Marine
Gross Area	Area: □ sq. ft. □ sq. m □ sq. mi. □ acres □ ha
Disturbances & impacts	
Associated species	
WEED DESCRIPTION	
Weed genus and species*	
Weed common name(s)	
Presence or Absence*	□ P □ A
Infested area*	Area: □ sq. ft. □ sq. meters □ sq. mi. □ acres □ ha
Canopy Cover*	Choose one: <1% 1-5% 5-25% 25-50% 50-75% 75-95% 95-100%
Appearance/phenology	Circle any: Germ'g./early growth New growth Flowering Seeding Senesc. Dead
Distribution pattern	Circle any: Clumpy Scattered patchy Scattered even Linear
Photo documentation	(Use table on back to log photos)
Weed Location	
Geo Feature type*	Circle one: Point Polygon Line

Geographic location*	GPS waypoint or feature ID: Coords. (if point): X: Y:
Coordinate system*	□ UTM Zone: □ Lat/Long dec. degs □ Other (specify):
Datum*	WGS 84/NAD83 Other (specify):
Location offset	Distance: feet meters Bearing/direction:
Location data accuracy*	□ <1m □ 1-5m □ 5-15m □ 15-100m □ 100m-1km □ 1km-10km >10km
Locality description	
Distance to water	Estimated distance: Horiz or Vert? Units:

Photo Log					
Photo #	GPS waypoint	X Coordinate	Y Coordinate	Bearing or Direction	**Feature/Notes**

Notes

Post-Construction Weed Monitoring Form

(CDFA, 2002)
(Fields marked with a * are required)

METADATA	
Collection date (mm/dd/yyyy)*	
Observer name*	
Observer contact information*	Address:
	City: State: Zip:
	Phone:
	Email:
Source of the data*	Organization name or WMA Code:
Hand-annotated map ID	
SITE DESCRIPTION	
Site name or ID*	
Site address/description	
State*	
County*	
National ownership*	
Local ownership	Landowner name:
Quad name	
HUC number	
Land use type	□ Ag □ Rangeland □ Rural Res. □ Urban □ Indust/Comm. □ Other
Invaded vegetation type	□ Forest □ Woodland □ Chap/Scrub □ Grassland □ Herb □ Aquatic-Fr □ Aquatic-Sa □ Marine
Gross Area	Area: □ sq. ft. □ sq. m □ sq. mi. □ acres □ ha
Disturbances & impacts	
Associated species	
WEED DESCRIPTION	
Weed genus and species*	
Weed common name(s)	
Presence or Absence*	□ P □ A
Infested area*	Area: sq. ft. sq. meters sq. mi. acres ha
Canopy Cover*	Choose one: <1% 1-5% 5-25% 25-50% 50-75% 75-95% 95-100%
Appearance/phenology	Circle any: Germ'g./early growth New growth Flowering Seeding Senesc. Dead
Distribution pattern	Circle any: Clumpy Scattered patchy Scattered even Linear
Spreading?	Edge advancing Edge stable Other:
Photo documentation	(Use table on back to log photos)

Weed Location	
Geo Feature type*	Circle one: Point Polygon Line
Geographic location*	GPS waypoint or feature ID: Coords. (if point): X: Y:
Coordinate system*	□ UTM Zone: □ Lat/Long dec. degs □ Other (specify):
Datum*	WGS 84/NAD83 Other (specify):
Location offset	Distance: □ feet □ meters Bearing/direction:
Location data accuracy*	□ <1m □ 1-5m □ 5-15m □ 15-100m □ 100m-1km □ 1km-10km □ >10km
Locality description	
Distance to water	Estimated distance: Horiz or Vert? Units:
ERADICATION	
Eradication plan*	
Dates of eradication measures (mm/dd/yyyy)*	Start and revisit dates: Completion date:
Post-eradication weed distribution compared to pre-eradication*	Greater Equal Reduced Eradicated Other:

Photo Log					
Photo #	GPS waypoint	X Coordinate	Y Coordinate	Bearing or Direction	**Feature/Notes**

Notes

Data Standards

[Excerpted from California Weed Mapping Handbook, draft, September 2002, by the California Department of Food and Agriculture.]

The following describes the standard data content elements that we have developed for California weed managers. The first part of the list describes categories you will need to collect when in the field. The second part of the list describes categories that could be recorded in the office, whether before the field outing or upon returning.

In the field

Collection Date: The full date on which the infestation was observed should be written on all paper forms in the format YYYYMMDD (or one you could convert to that format when it comes time to share the data). If you are using a GPS unit, the date will be automatically stored with each observation.

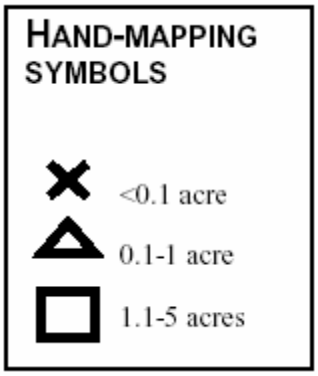
Observer: The full name of the person who observed the infestation should be written on all paper forms.

Site Name or ID, any site description information: Record a name for the site or an alphanumeric identifier and also put this on your hand-drawn map. Make any observations describing the site while there.

Genus/species: The scientific name for weeds should be used to avoid confusion. If you are using a mapping-grade GPS with a data dictionary, or digital form, you can create a menu to choose from. The Jepson manual, the CalFlora database (online at <www.calflora.org>), or the Integrated Taxonomic Information Systems (ITIS) can be used as sources of current scientific names. If you use a common name in the field you will need to translate it when you are back in the office.

Presence/Absence: This is implied as "presence" when there is information describing an infestation (such as cover class), but a simple absence report can be made for an area as well by stating the species and indicating the location, and saying it is "absent."

Gross Area and Infested Area: "Gross area" is an estimate of the size of the general region where the weeds occur and may be used when precision is either unnecessary or impractical (see further discussion of this in the Yellow star-thistle case study, Section 4.8). An example of the use of gross area is the identification of a 40-acre property that has weeds in large patches, but also has un-infested areas. The fact that the observer put "40 acres" in the gross area field correctly conveys the fact that a detailed survey was not



done. This associated with average cover density of the weed is a quick way to note the presence and severity of an infestation. In contrast," infested area" is an estimate of the size of the *specific* region in which the weed occurs, mapped more carefully by thoroughly observing the site and estimating the area of the land covered by the weed (whether it's sparse or dense cover). When hand mapping, we recommend the use of point symbols (shown at right) to mark infestations under five acres. For infestations five acres and larger, draw the areas onto the map (assuming you are using a map with 1:24,000 scale such as a USGS topo quad). Avoid drawing areas or lines if there are not clear reference features by which to judge location, as it may be misleading. If you use colors or abbreviations as codes (to indicate the type of weed, for example), be sure to write a key to the code on every document where the code is used. If you are using a GPS unit to measure location, you should record the size of the infestation in acres.

COVER CLASSES

(BASED ON DAUBENMIRE)

Cover Class	Range of Coverage	Midpoint of Range
TRACE	<1%	--
1	1- 5%	2.5%
2	5- 25%	15.0%
3	25 - 50%	37.5%
4	50 - 75%	62.5%
5	75 - 95%	85.0%
6	95 - 100%	97.5%

NATIONAL OWNERSHIP CODES

Listed below are codes that are likely to be useful in California. For a full list, see Appendix C of the NAWMA guidelines at www.nawma.org. This webpage includes information on specific tribal codes for reservations.

ARS	Agricultural Research Svc.
ALOT	Native American Allotments
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Mgmt.
CGOV	County-owned lands
DOD	Department of Defense
NPS	National Park Service
NRCS	Natural Resources Conservation Svc.
PVLA	Privately-owned lands
STAT	State-owned lands
TNC	The Nature Conservancy
TRIB	Tribal lands
UNIV	University lands
USFS	US Forest Service
USFW	US Fish & Wildlife Service
USGS	US Geological Survey
USOT	US Government - Other

Canopy Cover: Canopy cover is percent of the infested area covered by the weed being surveyed. One way to think of this is to visualize all of the weeds pushed together until their canopies touch, and then estimate this area and the portion of the overall infested area that this represents. Classify the cover into one of the categories listed at right.

National Ownership, Local Ownership: Record the national ownership code, as listed in the table on the following page. State ownership codes may also be developed in the future. Local ownership can be recorded as the name and contact information of the party who owns the property for future reference.

Geographic Location: If you are hand-mapping, indicate on your map with the desired symbol and give the feature an identifying alphanumeric identifier. Put this feature ID into the form that contains the descriptive information for that location. If you are writing down coordinates from a GPS unit, be careful of transcription errors as small numerical mistakes can translate into big geographic errors. It's helpful to stick with one coordinate system displayed in a consistent format, know what those numbers should look like, and always mind your decimals. If you are storing points in your recreation-grade GPS unit, or points, lines, and polygons in your mapping-grade GPS unit, your location data is stored digitally. GPS data is automatically stored by the unit in the pre-chosen format, the default of which is usually latitude and longitude in WGS84. Once this is downloaded to your computer, you can convert the data into any projection you need. If you are creating polygons or line features with a GPS, the data is more complex and will be handled entirely in its digital form.

Coordinate System and Datum: Record the coordinate system in which you are recording data. This includes the projection and datum—for instance, UTM Zone 10 NAD83. It's best to set this up in advance, whether by choosing the coordinate system that is displayed by the GPS unit, or decided how coordinates will be taken from a map.

Location Accuracy: Location accuracy refers to the closeness of the coordinates recorded to the real-world location (which can also be thought of as the "fuzziness" of the data). High accuracy in location reporting is not always necessary or desired- the important thing for future data interpretation is to record it, whether it is high or low! Location accuracy takes both the accuracy of the mapping method and the intended exactness of the location data into account for a number that indicates how much error or fuzziness should be considered part of the data. Note: "precision" and "accuracy" are different- precision essentially refers to the number of decimal places, so a very high precision GPS instrument can give you a high-precision location number with 6 decimal places, but still be inaccurate as far as its closeness to the real-world location you're trying to record.

Location Offset: Location offset is the direction and distance to the target location. Sometimes you can't stand right on the clump of weeds, but you'd like to record which way and how far to look when you get to that waypoint.

Weed Description Information: The parts of the form that describe the weed infestation, appearance/phenology and distribution pattern, along with documenting photos, should of course be filled out while in the field. Use the pick-lists for descriptors as presented in the sample field form.

In the Office

Make sure to record the following information. It is not critical to record this information in the field—it can be done in the office (promptly) after the field work.

Observer Contact Information: This may be the same as the organization contact information, and so you won't probably need to write it on every form. The purpose of this information is to allow for contacting the observer should there be questions about the data later on.

Keep contact information up to date.

Source of Data: Record the full name of the agency or organization responsible for collecting the data. If the agency has a national ownership code, that may be used. Again important mostly when you decide to send the data to someone outside the organization.

County: Record the county name, or the state code, or the six-digit FIPS (Federal Information Processing Standards) code for your county.

HUC Code (for aquatic weeds only): Look up and record the Hydrologic Unit Code for the watershed in which the aquatic weed occurs. See the USGS HUC website at http://water.usgs.gov/GIS/huc.html.

Photo Log					
Photo #	GPS waypoint or feature #	X Coordinate	Y Coordinate	Bearing or Direction	Feature/Notes

Notes

Attach this form to hand-drawn map and write the date, observer name, and the site and feature numbers on the map for easy cross-referencing.

APPENDIX B

Photographs of Noxious Weeds

B1 - Purple star-thistle
(Brother Alfred Brousseau. 1995. Calphotos.)

B2 - Yellow star-thistle
(Jo-Ann Ordano. 2000. Calphotos.)

SOURCE: ESA

B3 - Skeleton weed
(CDFA. 2001. Calphotos.)

B4 - Perennial pepperweed
(J.P. clark. 2001. Calphotos.)

SOURCE: ESA

B5 - Medusahead
(Carol W. whitham. 2004. Calphotos.)

B6 - Giant reed
(richard B. Lewis, III. 2004. Calphotos.)

SOURCE: ESA

B7 -Saltcedar
(Joseph DiTomaso. 2000. Calphotos.)

SOURCE: ESA